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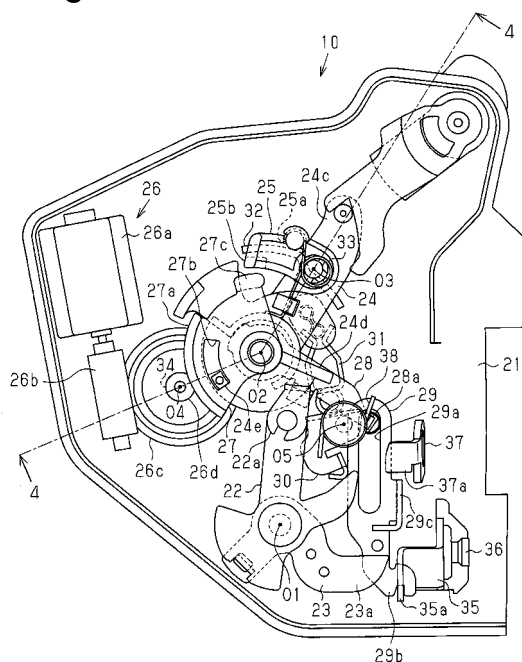
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(54) **DOOR LOCK DEVICE**

(57) A door lock device includes an electrical drive source, which pivots a drive member from a predetermined neutral position, and a return urging member, which returns the drive member to the predetermined neutral position. The drive member pushes a locking lever with a first engagement portion and moves the locking lever to a lock position when the drive member moves from the predetermined neutral portion in a first direction in a state in which the locking lever is arranged at an unlock position. The drive member allows the double lock lever to move to the second position and disengages the first engagement portion from the locking lever when subsequently returned to the predetermined neutral position. The drive member pushes the double lock lever with a second engagement portion when moved again from the predetermined neutral position in the first direction.

**Fig.3**



## Description

**[0001]** The present invention relates to a door lock device.

**[0002]** In the prior art, there is a door lock device that is capable of switching a vehicle door between the three states of an unlock state, a lock state, and a double lock state (super lock state) with a single motor and without executing electrical control. In the double lock state, the shifting of the vehicle door from the lock state to the unlock state by an operation performed in the passenger compartment is prohibited. Patent document 1 describes an example of such a door lock device. In this door lock device, a motor powers and rotates a rotary member in a forward direction from a neutral position. This moves a sill knob drive lever to a lock side and switches a lock mechanism to a lock state but does not move an operation lever, which counters the elastic force of a holding spring. When the lock mechanism switches to the lock state, the motor is deactivated. Accordingly, the elastic force of a neutral return spring returns the rotary member to a neutral position and the elastic force of the holding spring returns the operation lever to a predetermined position. Then, when the rotary member rotates again in the forward direction, the operation lever moves against the elastic force of the holding spring and moves a switching lever. This moves an engagement pin to a position that activates a swinging mechanism. The rotary member includes a super lock cancellation step. When the rotary member rotates in a reverse direction, the super lock cancellation step engages the switching lever and moves the engagement pin to a position that deactivates the swinging mechanism.

## PRIOR ART DOCUMENT

## PATENT DOCUMENT

### [0003]

Patent Document 1 ... Japanese Laid-Open Patent Publication No. 7-71151

## SUMMARY OF THE INVENTION

## PROBLEMS THAT ARE TO BE SOLVED BY THE INVENTION

**[0004]** In patent document 1, the sill knob drive lever only moves between an unlock side (unlock position) and a lock side (lock position). In other words, the switching of the vehicle door to the double lock state is performed using the operation lever and a link mechanism, which includes the switching lever, intermediate lever, and bent lever. Accordingly, these dedicated components, which are used to switch the vehicle door to a double lock state, results in the door lock device having a complicated structure.

**[0005]** It is an object of the present invention to provide a door lock device having a simplified structure that is capable of switching a vehicle door between the three states of an unlock state, a lock state, and a double lock state (super lock state) with a single electrical drive source and without the need for electrical control to be executed.

## MEANS FOR SOLVING THE PROBLEMS

**[0006]** To achieve the above-described object, one aspect of the present invention provides a door lock device including a latch mechanism, a locking lever, a double lock lever, an electrical drive source, a drive member, and a return urging member. The latch mechanism holds a vehicle door in a state closing a vehicle body. The latch mechanism is operated to be in a state allowing for the vehicle door to open the vehicle body when operation force from a passenger compartment or operation force from outside the passenger compartment is transmitted. The locking lever is linked to the vehicle door and is switchable between an unlock position, a lock position, and a double lock position. The locking lever when arranged at the unlock position allows the transmission of the operation force from the passenger compartment or the operation force from outside the passenger compartment to the latch mechanism. The locking lever when arranged at the lock position disables transmission of the operation force from outside the passenger compartment to the latch mechanism and allows the operation force from the passenger compartment to be applied to the locking lever thereby moving the locking lever to the unlock position. The locking lever when arranged at the double lock position disables transmission of the operation force from outside the passenger compartment to the latch mechanism and prevents movement of the locking lever to the unlock position or the lock position even when the operation force from the passenger compartment is applied to the locking lever. The double lock lever is coupled to the locking lever and moved to a first position and a second position respectively corresponding to the unlock position and the lock position of the locking lever. The drive member is linked to the vehicle door and includes a first engagement portion engageable with the locking lever and a second engagement portion engageable with the double lock lever. The drive member is driven by the electrical drive source from a neutral position in a first direction and a second direction that is opposite to the first direction. A return urging member returns the drive member to the neutral position when the electrical drive source stops operating. The drive member is formed to push the locking lever with the first engagement portion and move the locking lever to the lock position while restricting movement of the double lock lever to the second position when the drive member moves from the neutral portion in the first direction in a state in which the locking lever is arranged at the unlock position. The drive member is formed to disengage from the double lock

lever when the drive member subsequently returns to the predetermined neutral position to allow the double lock lever to move to the second position and disengage the first engagement portion from the locking lever. The drive member is formed to push the double lock lever, which is located at the second position, with the second engagement portion and move the locking lever to the double lock position when the drive member moves again in the first direction from the neutral position.

**[0007]** Preferably, the door lock device further includes a base member fixed to the vehicle door and a stopper formed on the base member. The drive member is formed to push the locking lever with the first engagement portion and move the locking lever to the lock position at which the double lock lever engages with the stopper while restricting movement of the double lock lever to the second position when the drive member moves from the neutral portion in the first direction in a state in which the locking lever is arranged at the unlock position. The drive member is formed to be disengaged from the double lock lever when the drive member subsequently returns to the neutral position to allow the double lock lever to move to the second position. The double lock lever is formed to disengage from the stopper when moved to the second position thereby allowing the locking lever to move from the lock position to the double lock position.

**[0008]** Preferably, the base member further includes a guide. The stopper includes a first guide portion and a second guide portion. The first guide portion is formed to guide the double lock lever in a state held at the first position when the locking lever moves from the unlock position to the lock position. The second guide portion is formed to guide the double lock lever in a state held at the second position when the locking lever moves from the lock position to the double lock position.

**[0009]** In the structures described above, the switching of the vehicle door to the unlock state, the lock state, and the double state is performed without executing electrical control and by performing driving the drive member in the first direction and second direction with the electrical drive source. More specifically, the states of engagement of the drive member with the locking lever and the double lock lever is changed in accordance with the movements of the locking lever and the double lock lever to switch the states of the vehicle door. Accordingly, the switching of the vehicle door to the unlock state, the lock state, and the double lock state is performed with an extremely simple structure including the locking lever, which moves between the three positions of the unlock position, the lock position, and the double lock position, and the double lock lever, which moves in cooperation with the locking lever. Further, the number of components related with the switching is reduced.

**[0010]** Preferably, the drive member and the locking lever are pivotally supported by the base member so as to be coaxial.

**[0011]** In this structure, the layout space for the drive member and the locking lever is decreased thereby al-

lowing for reduction in the overall size. In particular, the locking lever is moved to the unlock position, the lock position, and the double lock position by pivoting about the same axis. This allows for the overall door lock device to be reduced in size.

**[0012]** Preferably, the door lock device further includes two hooking projections arranged next to each other on the locking lever and a holding member supported on the base member. The holding member is formed to elastically clamp a different number of the hooking projections in correspondence with each of the unlock position, the lock position, and the double lock position of the locking lever.

**[0013]** In this structure, the holding member selectively clamps the two hooking projections, which are arranged next to each other on the locking lever. This stably holds the locking lever at the unlock position, the lock position, and the double lock position. In particular, the holding member elastically clamps a different number of the hooking projections to hold the locking lever at each of the unlock position, the lock position, and the double lock position of the locking lever. Thus, a versatile holding member (e.g., snap pin) that basically clamps the required projections in a selective manner may be used as the holding member.

## BRIEF DESCRIPTION OF THE DRAWINGS

### **[0014]**

Fig. 1 is a front view showing a vehicle door to which a door lock device according to one embodiment of the present invention is applied;

Fig. 2 is an elevated view showing a latch mechanism of a latch mechanism in the door lock device;

Fig. 3 is a side view showing the door lock device and its movement;

Fig. 4 is a cross-sectional view taken along line 4-4 in Fig. 3;

Fig. 5 is a side view showing the door lock device and its movement;

Fig. 6 is a side view showing the door lock device and its movement;

Fig. 7 is a side view showing the door lock device and its movement;

Fig. 8 is a side view showing the door lock device and its movement;

Fig. 9 is a side view showing the door lock device and its movement; and

Fig. 10 is a side view showing the door lock device and its movement.

## EMBODIMENTS OF THE INVENTION

**[0015]** One embodiment of the present invention will now be discussed with reference to the drawings.

**[0016]** As shown in Fig. 1, a door lock device 10 is arranged in a vehicle door 1 along a rear edge of the

vehicle door 1. The door lock device 10 is engaged with a striker 2, which is fixed to a vehicle body 5, to hold the vehicle door 1 in a state closing the body 5. The vehicle door 1 has an inner wall on which an inside handle 3 is arranged in a state exposed to the passenger compartment. The vehicle door 1 also has an outer wall on which an outside handle 4 is arranged in a state exposed to the outside of the passenger compartment. The door lock device 10 of the present embodiment is of a so-called knobless type, which does not include a lock knob in the passenger compartment for unlocking and locking operations.

**[0017]** As shown in Fig. 2, the door lock device 10 includes a latch mechanism 11, with the latch mechanism 11 including a latch 12 and a pole 13. The latch mechanism 11 engages the striker 2 to hold the vehicle door 1 in a state closing the vehicle body 5. When closing the vehicle door 1, the latch 12 rotates in a first direction and engages the striker 2. Further, the pole 13 engages the latch 12 to hinder rotation of the latch 12 and hold the vehicle door 1 in a closed state. When the pole 13 is rotated to permit rotation of the latch 12, the urging force of a return spring (not shown) rotates the latch 12 in a second direction, which is opposite the first direction. This disengages the latch 12 and the striker 2 thereby allowing the vehicle door 1 to open the vehicle body 5.

**[0018]** The door lock device 10 will now be described in detail with reference to Figs. 3 to 10. Fig. 3 is a side view showing the door lock device 10. Fig. 4 is a cross-sectional view taken along line 4-4 in Fig. 3. Fig. 4 is an enlarged view showing some members of Fig. 3.

**[0019]** As shown in Fig. 3, the door lock device 10 includes a box-shaped housing 21 serving as a base member fixed to the vehicle door 1, an inside lever 22, an inside open lever 23, an active lever 24 serving as a locking lever, a double lock lever 25, a switching actuator 26 serving as an electrical drive source, a sector gear 27 serving as a drive member, a panic lever 28, an open link 29, and a cancel lever 30.

**[0020]** As shown in Figs. 3 and 5, the inside lever 22, which is formed, for example, by a metal plate, is supported by the housing 21 to be pivotal about a rotation axis 01 in the clockwise direction and counterclockwise direction in a state arranged at a predetermined initial pivot position. The inside lever 22 extends upward as viewed in Fig. 3 and includes a distal portion bent back toward the rotation axis 01 and defining a scissor-shaped hooking piece 22a. The hooking piece 22a is linked to the inside handle 3 and pivots in the counterclockwise direction as viewed in Figs. 3 and 5 when an opening operation is performed with the inside handle 3. The inside lever 22 includes a hook-shaped pushing piece 22b extending in a first radial direction (upper right side as viewed in Fig. 5) relative to the rotation axis 01.

**[0021]** The inside open lever 23, which is formed, for example, by a metal plate, is arranged at a far side of the inside lever 22 in a direction perpendicular to the plane of the drawing and supported by the housing 21 to be

pivotal about the rotation axis 01 in the clockwise direction and counterclockwise direction. The inside open lever 23 is coupled to the inside lever 22 so as to pivot integrally with the inside lever 22. The inside open lever 23 includes a hook-shaped pushing piece 23a extending in a second radial direction (lower right side as viewed in Fig. 5) relative to the rotation axis 01.

The pushing piece 23a is spaced apart from the pushing piece 22b of the inside lever 22 in a circumferential direction that extends about the rotation axis 01.

**[0022]** The active lever 24 is formed, for example, from a resin material and arranged at an upper side of the inside lever 22 as viewed in Fig. 5. The active lever 24 is supported by the housing 21 to be pivotal about a rotation axis 02, which is parallel to the rotation axis 01, in the clockwise direction and counterclockwise direction. The housing 21 restricts the pivoting of the active lever 24 within a predetermined range. The active lever 24 includes two hooking projections 24a and 24b, which are arranged next to each other along a circumferential direction extending about the rotation axis 02. The hooking projections 24a and 24b have peripheral positions that are arranged adjacently and continuously to define an overall "8"-shaped form. The hooking projections 24a and 24b are arranged at a far side in a direction perpendicular to the plane of the drawing, that is, toward a bottom wall side of the housing 21. A restraining spring 31, which serves as a holding member that positions the active lever 24, is secured to the housing 21 (bottom wall). The restraining spring 31 includes a coil portion and two L-shaped end portions 31a and 31b, which extend from the coil portion. The restraining spring 31 is formed by a so-called snap pin and produces an urging force in a direction in which the distance between the end portions 31a and 31b decreases. The restraining spring 31 elastically clamps the hooking projections 24a and 24b to maintain the pivotal position of the active lever 24.

**[0023]** Figs. 3, 5, and 10 show the active lever 24 in a state arranged at an unlock position. In this state, the housing 21 restricts pivoting of the active lever 24 in the counterclockwise direction, and the restraining spring 31 does not clamp any one of the hooking projections 24a and 24b. Figs. 6 and 7 show the active lever 24 in a state arranged at a lock position. In this state, the active lever 24 pivots for only a predetermined angle from the unlock position in the clockwise direction, and the restraining spring 31 clamps just the hooking projection 24a. Figs. 8 and 9 show the active lever 24 in a state arranged at a double lock position. In this state, the active lever 24 pivots for only a predetermined angle from the lock position in the clockwise direction, the housing 21 restricts pivoting of the active lever 24 in the clockwise direction, and the restraining spring 31 clamps every one of the hooking projections 24a and 24b. In this manner, the restraining spring 31 elastically clamps a different number of the hooking projections 24a and 24b in correspondence with the unlock position, lock position, and double lock position of the active lever 24.

**[0024]** The active lever 24 includes a coupling piece 24c, which extends in a first radial direction (upper side as viewed in Fig. 3) relative to the rotation axis 02, and an abutment piece 24d, which extends to the vicinity of the cancel lever 30 in a second radial direction (lower right side as viewed in Fig. 3) relative to the rotation axis 02.

The active lever 24 includes a polygonal boss 24e, which has the shape of a tetragonal rod and extends toward a near side in a direction perpendicular to the plane of the drawing from a leftward position of the sector gear 27 as viewed in Fig. 5.

**[0025]** The double lock lever 25 is molded, for example, from a resin material and supported by the coupling piece 24c of the active lever 24 to be pivotal about a rotation axis 03, which is parallel to the rotation axes 01 and 02, in the clockwise direction and counterclockwise direction. The double lock lever 25 includes a guide pin 25a arranged at a far side in a direction perpendicular to the plane of the drawing from the left side of the coupling piece 24c as viewed in Fig. 5, that is, toward a bottom wall side of the housing 21. A rib-shaped guide 32, which can abut on the guide pin 25a, is formed on the housing 21 (bottom wall) at an inner circumferential side of the guide pin 25a relative to the rotation axis 02. As shown in Fig. 5, the guide 32 includes a first guide portion 32a and a second guide portion 32b, which are arc-shaped and extend in the circumferential direction about the rotation axis 02. The second guide portion has an outer diameter that is shorter than that of the first guide portion 32a. The second guide portion 32b is arranged adjacent to the first guide portion 32a at the clockwise side. An inclined guide portion 32c smoothly connects a step extending between the first and second guide portions 32a and 32b along a radial direction of the rotation axis 02.

**[0026]** The double lock lever 25 includes a distal portion 25b. The distal portion 25b includes a block-shaped stopper 25c, which extends toward the far side in a direction perpendicular to the plane of the drawing, that is, toward the bottom wall of the housing 21. The stopper 25c is arranged at an inner circumferential side of the guide 32 (first guide portion 32a). The guide 32 includes a step 32d, which is located at the inner circumferential side of the inclined guide portion 32c relative to the rotation axis 02 and extends in a radial direction relative to the rotation axis 02.

**[0027]** A torsion coil spring 33, which serves as an urging member, is arranged about the rotation axis 03. The torsion coil spring 33 has one end hooked to the active lever 24 and another end hooked to the double lock lever 25 (refer to Fig. 3). This constantly urges the lock lever 25 in a direction in which the guide pin 25a abuts on the guide 32 (counterclockwise direction extending about the rotation axis 03 of the guide pin 25a in Fig. 3).

**[0028]** When the active lever 24 is located at the unlock position, the guide pin 25a abuts on the first guide portion 32a (refer to Fig. 5). The pivot position of the double lock lever 25 in this state is referred to as the first position of

the double lock lever 25. When the active lever 24 is located at the lock position or the double lock position, the guide pin 25a abuts on the second guide portion 32b (refer to Figs. 7 to 9). The pivot positions of the double lock lever 25 in such states are referred to as the second positions of the double lock lever 25.

**[0029]** The double lock lever 25, which is guided by the guide 32, extends in an arc-like manner in the circumferential direction about the rotation axis when located at the first position. Further, the step 32d is arranged along a pivot path of the stopper 25c extending about the rotation axis 02. Accordingly, when the active lever 24 is pivoted in the clockwise direction to move from the unlock position to the lock position, as the first guide portion 32a guides the double lock lever 25, which moves in cooperation with the active lever 24, the stopper 25c of the double lock lever 25 abuts on the step 32d. This stops the pivoting of the active lever 24 and the double lock lever 25 (refer to Fig. 6). In other words, the abutment of the stopper 25c and the step 32d stops the active lever 24 at the lock position. Further, the double lock lever 25 is pivoted by an amount corresponding to the step in the radial direction between the first and second guide portions 32a and 32b relative to the rotation axis 03, that is, in the direction that the distal portion 25b moves inward in the radial direction relative to the rotation axis 02. Then, the step 32d moves out of the pivot path of the stopper 25c about the rotation axis 02.

**[0030]** The switching actuator 26 includes an electric motor 26a, a worm 26b, and a worm wheel 26c. The electric motor 26a is arranged in the housing 21 at the left side of the active lever 24 as viewed in Fig. 3. The worm wheel 26c is arranged at the far side of the sector gear 27 and the active lever 24 in the direction perpendicular to the plane of the drawing. Further, the worm wheel 26c is supported by the housing 21 to be rotatable about a rotation axis 04, which is parallel to the rotation axes 01 to 03. The worm wheel 26c has a central portion to which a small-diameter output gear 26d is fixed in a state extending toward the near side in the direction perpendicular to the plane of the drawing. The output gear 26d rotates integrally with the worm wheel 26c. Accordingly, when the electric motor 26a is driven to produce rotation, the worm 26b and worm wheel 26c (worm gear) rotate the output gear 26d.

**[0031]** The sector gear 27 is molded, for example, from a resin material, arranged at the near side of the active lever 24 in the direction perpendicular to the plane of the drawing, and supported by the housing 21 to be pivotal about the rotation axis 02 in the clockwise direction and counterclockwise direction. The active lever 24 or the double lock lever 25, which are engaged with the housing 21, restrict the pivoting of the sector gear 27 within a predetermined pivot range. The sector gear 27 includes a fan-shaped gear portion 27a, which extends from the rotation axis 02 toward the output gear 26d of the switching actuator 26. The axial position of the gear portion 27a coincides with the axial position of the output gear 26d.

The gear portion 27a and the output gear 26d are mated with each other, and the sector gear 27 is rotated and driven by the switching actuator 26. A return spring 34, which serves as a return urging member, is arranged about the rotation axis 04. The return spring 34 has one end hooked to the housing 21 and another end hooked to the worm wheel 26c. The return spring 34 constantly urges the sector gear 27 through the worm wheel 26c so as to return the pivot position of the sector gear 27 to a predetermined neutral position when the switching actuator 26 stops operating (stops generating drive force). In other words, the switching actuator 26 rotates and drives the sector gear 27 against the urging force of the return spring 34.

**[0032]** The sector gear 27 also includes an engagement hole 27b, which serves as a first engagement portion. The engagement hole 27b is arranged at an inner circumferential side of the gear portion 27a relative to the rotation axis 02 and extends in the circumferential direction about the rotation axis 02. The polygonal boss 24e is inserted into the engagement hole 27b from the far side in the direction perpendicular to the plane of the drawing. The engagement hole 27b has a first terminal end portion that abuts on or comes into the proximity of the polygonal boss 24e when the sector gear 27 is located at the predetermined neutral position and the active lever 24 is located at the unlock position (refer to Fig. 5). Accordingly, in this state, when the sector gear 27 pivots in the clockwise direction, an inner wall surface of the engagement hole 27b pushes the polygonal boss 24e, and the active lever 24 is pivoted integrally with the sector gear 27 in the clockwise direction. When the stopper 25c and the step 32d abut against each other, the active lever 24 stops at the lock position (refer to Fig. 6).

Further, when the sector gear 27 is located at the predetermined neutral position and the active lever 24 is located at the lock position, the polygonal boss 24e is arranged in the engagement hole 27b at a central portion in the longitudinal direction (refer to Fig. 7). Further, the pivot path of the stopper 25c about the rotation axis 02 is separated from the step 32d. Accordingly, in this state, when the sector gear 27 pivots in the clockwise direction or the counterclockwise direction, the polygonal boss 24e moves freely in the engagement hole 27b. When the sector gear 27 is located at the predetermined neutral position and the active lever 24 is located at the double lock position, a second terminal end portion of the engagement hole 27b opposite to the first terminal position abuts on or is in the vicinity of the polygonal boss 24e (refer to Fig. 9). Accordingly, in this state, when the sector gear 27 pivots in the counterclockwise direction, the inner wall surface of the engagement hole 27b pushes the polygonal boss 24e, and the active lever 24 pivots integrally with the sector gear 27 in the counterclockwise direction to move toward the unlock position. Then, the active lever 24 stops at the unlock position when the housing 21 restricts pivoting in the counterclockwise direction (refer to Fig. 10).

**[0033]** The sector gear 27 also includes a hammer-shaped pushing piece 27c, which serves as a second engagement portion. The pushing piece 27c is located at the inner circumferential side of the guide 32 relative to the rotation axis 02 and is extended to the vicinity of the double lock lever 25. The axial position of the pushing piece 27c conforms to the axial position of the double lock lever 25. The double lock lever 25 (distal portion 25b) is set to move out of the pivot path of the pushing piece 27c when the double lock lever 25 is located at the first position (refer to Fig. 5).

**[0034]** When the sector gear 27 is pivoted in the clockwise direction to move the active lever 24 to the lock position, the guide pin 25a of the double lock lever 25 is arranged at the outer circumferential side of the second guide portion 32b relative to the rotation axis 02 (refer to Fig. 6). Further, the double lock lever 25, which is urged by the coil spring 33 so as to move toward the second position, abuts on a peripheral surface 27d of the pushing piece 27c. This restricts the movement of the double lock lever 25. Accordingly, the active lever 24 moves to the lock position without interference with the double lock lever 25 and the sector gear 27.

**[0035]** When the switching actuator 26 stops operating after the active lever 24 moves to the lock position, the return spring 34 urges the sector gear 27 through the worm wheel 26c, pivots the sector gear 27 in the counterclockwise direction (recovery pivoting), and returns the sector gear 27 to the predetermined neutral position (refer to Fig. 7). This causes the sector gear 27 to disengage the double lock lever 25 from the peripheral surface 27d of the pushing piece 27c and allows for the double lock lever 25 to move to the second position. Further, the sector gear 27 arranges the polygonal boss 24e in the longitudinally central portion of the engagement hole 27b and disengages the polygonal boss 24e from the engagement hole 27b. The double lock lever 25 (distal portion 25b) is set to be arranged in the pivot path of the pushing piece 27c when located at the second position.

**[0036]** Accordingly, in this state, when the sector gear 27 pivots again in the clockwise direction, the pushing piece 27c pushes the double lock lever 25, which is located at the second position. This pivots the active lever 24, which is coupled to the double lock lever 25, in the clockwise direction about the rotation axis 02 integrally with the sector gear 27 and the double lock lever 25. Further, the active lever 24 stops at the double lock position when the housing 21 restricts pivoting in the clockwise direction about the rotation axis 02 (refer to Fig. 8). In this state, the polygonal boss 24e moves freely relative to the engagement hole 27b. Thus, the active lever 24 moves to the double lock position without interference with the polygonal boss 24e and the engagement hole 27b.

**[0037]** When the switching actuator 26 stops operating after the active lever 24 moves to the double lock position, the return spring 34 urges the sector gear 27 through the worm wheel 26c, pivots the sector gear 27 in the coun-

terclockwise direction (recovery pivoting), and returns the sector gear 27 to the predetermined neutral position (refer to Fig. 9). In this state, the second terminal end portion of the engagement hole 27b abuts on or is in the vicinity of the polygonal boss 24e.

**[0038]** When the sector gear 27 is pivoted in the counterclockwise direction (reverse pivoting) in this state, the inner wall surface of the engagement hole 27b pushes the polygonal boss 24e, and the active lever 24 pivots integrally with the sector gear 27 in the counterclockwise direction. Then, the housing 21 restricts pivoting in the counterclockwise direction and stops the active lever 24 at the unlock position (refer to Fig. 10). At the same time, the guide pin 25a, which is guided from the second guide portion 32b via the inclined guide portion 32c to the first guide portion 32a, moves the double lock lever 25 from the second position to the first position. Then, when the switching actuator 26 stops operating, the return spring 34 urges the sector gear 27 through the worm wheel 26c, pivots the sector gear 27 in the counterclockwise direction (recovery pivoting), and returns the sector gear 27 to the predetermined neutral position (refer to Fig. 5).

**[0039]** The switching actuator 26 is driven and controlled for a certain period when a control circuit (not shown) detects a remote operation performed on a switch arranged on a key blade or passenger compartment door trim. In this manner, except for the polarity of the supplied power being changed in accordance with the direction of the rotation produced by the electric motor 26a, the switching actuator 26 does not undergo special electrical control (position control). That is, the active lever 24 is mechanically engaged in the manner described above when the switching actuator 26 is being driven to selectively switch between the unlock position, the lock position, and the double lock position.

**[0040]** The panic lever 28 is formed, for example, by a metal plate and is supported by the housing 21 to be pivotal about the rotation axis 02 in the clockwise direction and counterclockwise direction. An urging member (not shown) is arranged on the rotation axis 02. The urging member has one end hooked to the active lever 24 and another end hooked to the panic lever 28. This basically pivots the panic lever 28 integrally with the active lever 24. Further, the panic lever 28 has a distal position to which a hooking pin 28a is secured extending in the near side in the direction perpendicular to the plane of the drawing.

**[0041]** The open link 29 is formed, for example, by a metal plate and extends in the vertical direction as viewed in Fig. 5. The open link 29 includes a first end portion with an engagement groove 29a, which has the form of an elongated hole and which receives the hooking pin 28a of the panic lever 28. The open link 29 is coupled to the panic lever 28 to be movable along the longitudinal direction of the engagement groove 29a.

**[0042]** The open link 29 also includes a second end portion, which is opposite to the first end portion, defining a coupling portion 29b coupled to an open lever 35, which

is arranged on the housing 21. The open link 29 is coupled to be tiltable relative to the open lever 35 and stably arranged at a predetermined pivot position by a torsion spring (not shown). The open lever 35 includes a first end portion 35a and a second end portion (not shown), which is arranged opposite to the first end portion 35a with a pivot axis of the open lever 35 arranged in between. The first end portion 35a is coupled to the coupling portion 29b of the open link 29. The second end portion of the open lever 35 is linked to the outside handle 4. When the outside handle 4 is operated in an opening direction, the open lever 35 pivots so that the first end portion 35a moves against the torsion spring, that is, moves the open link 29 upward.

**[0043]** Further, the open link 29 includes the coupling portion 29b, and an L-shaped engagement piece 29c is arranged between the engagement groove 29a and the coupling portion 29b. The engagement piece 29c is arranged in the vicinity of a lift lever 37, which is pivotally coupled to the housing 21. The lift lever 37 is coupled to the pole 13 (refer to Fig. 2) so as to pivot integrally with the pole 13. The lift lever 37 includes a distal portion 37a, which is located at the side closer to the engagement piece 29c. When the lift lever 37 is pivoted to move the distal portion 37a upward and the pole 13 pivots integrally, the latch mechanism 11 and the striker 2 are disengaged from each other thereby allowing the vehicle door 1 to open the vehicle body 5.

**[0044]** The engagement piece 29c is arranged along the vertical direction facing toward the pushing piece 23a of the inside open lever 23 and in the pivot path of the pushing piece 23a. Accordingly, for example, when the inside open lever 23 is pivoted in the counterclockwise direction, the pushing piece 23a pushes the end surface of the engagement piece 29c facing toward pushing piece 23a and moves the open link 29 upward.

**[0045]** The positional relationship of the engagement piece 29c and the distal portion 37a corresponding to the unlock position, lock position, and double lock position of the active lever 24 will now be discussed. When the active lever 24 is located at the unlock position (refer to Figs. 3 and 5), the hooking pin 28a of the panic lever 28 guides the first end portion of the open link 29 to a first side (right side as viewed in Figs. 3 and 5). In this state, the engagement piece 29c and the distal portion 37a are arranged facing toward each other in the vertical direction as viewed in Figs. 3 and 5, and the engagement groove 29a is arranged so that its longitudinal direction conforms to the vertical direction as viewed in Figs. 3 and 5. Accordingly, by moving the open link 29 (engagement piece 29c) upward in this state, the distal portion 37a is pushed by the open link 29 (engagement piece 29c) and moved upward in the manner described above thereby disengaging the latch mechanism 11 and the striker 2.

**[0046]** When the active lever 24 is located at the lock position (refer to Fig. 7) or the double lock position (refer to Fig. 9), the hooking pin 28a of the panic lever 28 guides the first end portion of the open link 29 to a second side

(left side as viewed in Figs. 7 and 9), which is opposite to the first side. In this state, the engagement piece 29c is arranged so that an extension line extending from the engagement piece 29c along the longitudinal direction of the engagement groove 29a is separated from the distal portion 37a. Accordingly, even when the open link 29 moves upward, the engagement piece 29c does not push and move the distal portion 37a upward, and the engagement of the latch mechanism 11 and striker 2 is maintained.

**[0047]** The cancel lever 30 is formed, for example, by a metal plate and arranged between the inside lever 22 and the active lever 24. The cancel lever 30 is supported by the housing 21 to be pivotal about a rotation axis 05, which is parallel to the rotation axes 01 to 04, in the clockwise direction and counterclockwise direction. The cancel lever 30 is formed to be U-shaped and includes a distal portion with a terminal end defining an abutment piece 30a. The abutment piece 30a is bent to be generally L-shaped in the vicinity of the pushing piece 22b. Further, the cancel lever 30 includes an engagement piece 30b, which serves as a third engagement portion, has a planar shape, and faces toward the abutment piece 24d.

**[0048]** A coil spring 38 is arranged on the rotation axis 05. The coil spring 38 has one end hooked to the housing 21 and another end hooked to the cancel lever 30 (refer to Fig. 3). The coil spring 38 constantly urges the cancel lever 30 toward the side the abutment piece 30a abuts on the pushing piece 22b of the inside lever 22 (the side in which pivoting occurs in the counterclockwise direction). Accordingly, the cancel lever 30 is held at a predetermined pivot position in correspondence with the inside lever 22 that is arranged at a predetermined initial pivot position. When the inside handle 3 is operated in an opening direction thereby pivoting the inside lever 22 in the counterclockwise direction, the cancel lever 30 is pivoted in the clockwise direction as the abutment piece 30a is pushed by the pushing piece 22b.

**[0049]** When the active lever 24 is located at the lock position (refer to Fig. 7), the abutment piece 24d is arranged in the pivot path of the engagement piece 30b. Accordingly, when the inside handle 3 is operated in the opening direction to pivot the cancel lever 30 in the clockwise direction in the manner described above, the engagement piece 30b pushes the abutment piece 24d. This pivots the active lever 24 in the counterclockwise direction and moves the active lever 24 to the unlock position. Further, after the active lever 24 moves to the unlock position, that is, after the engagement piece 29c and the distal portion 37a are arranged facing toward each other in the vertical direction, the pushing piece 23a of the inside open lever 23, which then pivots integrally with the inside lever 22, pushes the end surface of the engagement piece 29c that faces toward the pushing piece 23a. This disengages the latch mechanism 11 from the striker 2 in the manner described above. In this manner, the present embodiment employs a so-called one-motion mechanism that completes the shifting of the ve-

hicle door 1 from the lock state to the unlock state with a single operation of the inside handle 3, while disengaging the latch mechanism 11 from the striker 2.

**[0050]** When the active lever 24 is located at the double lock position (refer to Fig. 9), the abutment piece 24d is separated from the pivot path of the engagement piece 30b. Accordingly, even when the inside handle 3 is operated in the opening direction to pivot the cancel lever 30 in the clockwise direction in the manner described above, the engagement piece 30b does not push the abutment piece 24d. Further, the engagement piece 30b is disengaged from the abutment piece 24d (the engagement piece 30b moves freely). Accordingly, the active lever 24 remains stopped at the double lock position. In this case, the latch mechanism 11 and the striker 2 remain engaged with each other.

**[0051]** The operation of the present embodiment will now be discussed.

**[0052]** As shown in Fig. 5, in a state in which the active lever 24 is located at the unlock position (unlock state), when the switching actuator 26 is driven to pivot the sector gear 27 in the clockwise direction from the predetermined neutral position, the inner wall surface of the engagement hole 27b pushes the polygonal boss 24e. This moves the active lever 24 to the lock position (refer to Fig. 6). At the same time, the active lever 24 is held at the lock position with the hooking projection 24a being elastically clamped by the restraining spring 31. In this state, movement of the double lock lever 25 to the second position is restricted due to the abutment with the peripheral surface 27d of the pushing piece 27c.

**[0053]** After the pivoting restriction, which is caused by the abutment of the stopper 25c and the step 32d, moves the active lever 24 to the lock position, the operation of the switching actuator 26 is automatically stopped when a certain period elapses. The return spring 34 urges the sector gear 27 through the worm wheel 26c, pivots the sector gear 27 in the counterclockwise direction (recovery pivoting), and returns the sector gear 27 to the predetermined neutral position (refer to Fig. 7). This disengages the double lock lever 25 from the peripheral surface 27d of the pushing piece 27c and moves the double lock lever 25 to the second position. Then, the step 32d is separated from the pivot path of the stopper 25c extending about the rotation axis 02. Further, the polygonal boss 24e of the active lever 24 is arranged at the longitudinally central portion of the engagement hole 27b and disengaged from the engagement hole 27b.

**[0054]** In a state in which the active lever 24 is located at the lock position (lock state), when the switching actuator 26 is driven to pivot the sector gear 27 again in the clockwise direction from the predetermined neutral position, the pushing piece 27c pushes the double lock lever 25 (distal portion 25b), which is located at the second position. This moves the active lever 24, which is coupled to the double lock lever 25, to the double lock position (refer to Fig. 8). At the same time, the active lever 24 is held at the double lock position with the two hooking pro-



jections 24a and 24b being elastically clamped by the restraining spring 31. In this state, the polygonal boss 24e of the active lever 24 moves freely relative to the engagement hole 27b.

**[0055]** After the pivoting restriction, which is caused by the housing 21, moves the active lever 24 to the double lock position, the operation of the switching actuator 26 is automatically stopped when a certain period elapses. Then, the return spring 34 urges the sector gear 27 through the worm wheel 26c, pivots the sector gear 27 in the counterclockwise direction (recovery pivoting), and returns the sector gear 27 to the predetermined neutral position (refer to Fig. 9). In this state, the second terminal end portion of the engagement hole 27b abuts on or is in the vicinity of the polygonal boss 24e.

**[0056]** In a state in which the active lever 24 is located at the double lock position (double lock state), when the switching actuator 26 is driven to pivot the sector gear 27 in the counterclockwise direction (reverse pivoting) from the predetermined neutral position, the inner wall surface of the engagement hole 27b pushes the polygonal boss 24e.

**[0057]** This moves the active lever 24 to the unlock position (refer to Fig. 10). At the same time, the active lever 24 is held at the unlock position without any of the hooking projections 24a and 24b being elastically clamped by the restraining spring 31. In this state, the double lock lever 25 is guided by the guide 32 and moved to the first position.

**[0058]** After the pivoting restriction, which is caused by the housing 21, moves the active lever 24 to the unlock position, the operation of the switching actuator 26 is automatically stopped when a certain period elapses. The return spring 34 urges the sector gear 27 through the worm wheel 26c, pivots the sector gear 27 in the counterclockwise direction (recovery pivoting), and returns the sector gear 27 to the predetermined neutral position (refer to Fig. 5).

**[0059]** In this manner, in the present embodiment, the switching actuator 26 pivots the sector gear 27 while the urging force of the return spring 34 returns the sector gear 27 to the predetermined position without the need for special electrical control (position control). This selectively switches the vehicle door 1 between the unlock state, lock state, and double lock state.

**[0060]** When the active lever 24 is located at the lock position (refer to Fig. 7), a single operation of the inside handle 3 completes the shifting of the vehicle door 1 to the unlock state in the manner described above, while disengaging the latch mechanism 11 from the striker 2. When the active lever 24 is located at the double lock position (refer to Fig. 9), the cancel lever 30 swings in the above-described manner even if the inside handle 3 is operated. Thus, the vehicle door 1 does not shift to the unlock state or the like.

**[0061]** As described above in detail, the present embodiment has the advantages described below.

(1) In the present embodiment, the single switching actuator 26 (electric motor 26a) drives the sector gear 27 in a first direction and a second direction to switch the vehicle door 1 to the unlock state, lock state, and double lock state. Further, the switching is performed without executing electrical control. In detail, the states of the vehicle door 1 are switched by changing the engagement states of the sector gear 27 with the active lever 24 and the double lock lever 25. Accordingly, the switching to the unlock state, lock state, and double lock state is performed with an extremely simple structure including the active lever 24, which moves to the unlock position, the lock position, and the double lock position, and the double lock lever 25, which moves in cooperation with the active lever 24. Further, the number of components used for the switching may be reduced.

(2) In the present embodiment, the sector gear 27 and the active lever 24, which are pivotally coupled to the housing 21, are coaxial (rotation axis 02). This decreases the layout space for the sector gear 27 and active lever 24 and allows for miniaturization. In particular, the active lever 24 pivots about the same axis (rotation axis 02) to move to the unlock position, the lock position, and the double lock position (i.e., switch the vehicle door 1 to the unlock state, the lock state, and the double lock state). This allows for the overall door lock device to be reduced in size.

(3) In the present embodiment, the restraining spring 31 selectively clamps the two hooking projections 24a and 24b, which are arranged next to each other on the active lever 24, to stably hold the active lever 24 at the unlock position, the lock position, and the double lock position. In particular, the restraining spring 31 holds the active lever 24 at the unlock position, the lock position, and the double lock position by elastically clamping a different number of the hooking projections 24a and 24b for each position. Thus, a versatile snap pin that basically clamps the required projections in a selective manner may be used as the restraining spring 31.

(4) In the present embodiment, without executing electrical control, the single switching actuator 26 switches the vehicle door 1 to the unlock state, the lock state, and the double lock state. Thus, for example, a sensor or the like for detecting the pivot position of the active lever is unnecessary, and the electrical structure may be simplified thereby reducing costs. Further, when arranging the active lever 24 at the unlock position, the lock position, or the double lock position, the movement of the active lever 24 caused by the drive force of the switching actuator 26 is mechanically stopped. Thus, in comparison to when detecting the position of the active lever with, for example, a sensor or the like, the position of the active lever 24 is prevented from varying. This improves the reliability of the overall device.

(5) In the present embodiment, when in the lock

state, the inside handle 3 is operated (operation force from the passenger compartment is received) to move the inside lever 22. As a result, the abutment piece 24d of the active lever 24 pushes the engagement piece 30b of the cancel lever 30, which moves integrally with the inside lever 22, and the active lever 24 may be moved to the unlock position. In particular, when the door lock device is of a knobless type structure, the movement of the inside lever 22 caused by the receipt of the operation force from the passenger compartment moves the active lever 24 to the unlock position.

**[0062]** The embodiment discussed above may be modified as described below.

**[0063]** The first guide portion 32a and the second guide portion 32b do not necessarily have to be arc-shaped and may be linear.

**[0064]** The first guide portion 32a does not necessarily have to be included in the guide 32, and the sector gear 27 may have the function of the first guide portion 32a. In detail, when moving the active lever 24 from the unlock position to the lock position, as long as the sector gear 27 abuts on the double lock lever 25 and holds the double lock lever 25 at the first position, the first guide portion 32a is not necessary.

**[0065]** In the above-described embodiment, the housing 21 restricts the pivoting of the active lever 24 to stop the active lever 24 at the unlock position or the lock position. However, the embodiment described above is not limited to the foregoing description. For example, pivoting of the sector gear 27 may be restricted with the housing 21 so that the active lever 24, which moves in cooperation with the sector gear 27, stops at the unlock position or the lock position.

**[0066]** In the above-described embodiment, the return urging member (return spring 34) urges the worm wheel 26c and returns the sector gear 27 to the predetermined neutral position. However, the embodiment described above is not limited to the foregoing description and the return urging member may urge a member other than the worm wheel 26c at the upstream side of the rotary shaft of the electric motor 26a with respect to power transmission. For example, the return urging member may directly urge the sector gear 27 to return the sector gear 27 to the predetermined neutral position. The structure for power transmission between the rotary shaft of the electric motor 26a and the sector gear 27 is just one example. For instance, the worm 26b of the electric motor 26a may be directly mated with the gear portion 27a of the sector gear 27.

**[0067]** In the above-described embodiment, the peripheral portions of the adjacent hooking projections 24a and 24b are connected to be integral. However, the hooking projections 24a and 24b may be separated from each other.

**[0068]** The inside lever 22 and the inside open lever 23 may be formed integrally.

**[0069]** The base member (housing 21) to which the active lever 24 and the like are coupled may be a suitable bracket fixed to the vehicle door 1 or a frame that forms the framework of the vehicle door 1.

**[0070]** When the vehicle door 1 is in the lock state, the shifting to the unlock state may be completed by a single operation of the inside handle 3. Accordingly, the disengagement of the latch mechanism 11 and the striker 2 may be performed by a second operation of the inside handle 3 (so-called two-motion mechanism).

**[0071]** The present invention may be applied to a door lock device including a lock knob. In this case, only lock operations from the passenger compartment with the lock knob are permitted, and unlocking operations are prohibited by using a suitable swinging mechanism. When applying such a lock knob, the "operation force from a passenger compartment" recited in claim 1 may be the operation force of the inside handle 3 or the operation force of the lock knob. Alternatively, after the lock operation of the lock knob from the passenger compartment, the lock knob may be drawn into the vehicle door 1 so as to disable direct operation. When using such a drawn-in type lock knob, the "operation force from a passenger compartment" recited in claim 1 may be the operation force of the inside handle 3.

## DESCRIPTION OF THE REFERENCE CHARACTERS

**[0072]** 1 ... vehicle door, 10 ... door lock device, 11 ... latch mechanism, 21 ... housing (base member), 22 ... inside lever, 24 ... active lever (locking lever), 24a and 24b ... hooking projections, 25 ... double lock lever, 26 ... switching actuator (electrical drive source), 27 ... sector gear (drive member), 27b ... engagement hole (first engagement portion), 27c ... pushing piece (second engagement portion), 30 ... cancel lever, 31 ... restraining spring (holding member), 32 ... guide, 32a ... first guide portion, 32b ... second guide portion, 32d ... step (stopper), 34 ... return spring (return urging member).

## Claims

### 1. A door lock device comprising:

a latch mechanism that holds a vehicle door in a state closing a vehicle body, the latch mechanism being operated to be in a state allowing for the vehicle door to open the vehicle body when operation force from a passenger compartment or operation force from outside the passenger compartment is transmitted;  
a locking lever linked to the vehicle door and being switchable between an unlock position, a lock position, and a double lock position, the locking lever when arranged at the unlock position allowing the transmission of the operation force from the passenger compartment or the

- operation force from outside the passenger compartment to the latch mechanism, the locking lever when arranged at the lock position disabling transmission of the operation force from outside the passenger compartment to the latch mechanism and allowing the operation force from the passenger compartment to be applied to the locking lever thereby moving the locking lever to the unlock position, and the locking lever when arranged at the double lock position disabling transmission of the operation force from outside the passenger compartment to the latch mechanism and preventing movement of the locking lever to the unlock position or the lock position even when the operation force from the passenger compartment is applied to the locking lever;
- a double lock lever coupled to the locking lever and moved to a first position and a second position respectively corresponding to the unlock position and the lock position of the locking lever; an electrical drive source;
- a drive member linked to the vehicle door and including a first engagement portion engageable with the locking lever and a second engagement portion engageable with the double lock lever, the drive member being driven by the electrical drive source from a neutral position in a first direction and a second direction that is opposite to the first direction; and
- a return urging member that returns the drive member to the neutral position when the electrical drive source stops operating;
- wherein the drive member is formed to push the locking lever with the first engagement portion and move the locking lever to the lock position while restricting movement of the double lock lever to the second position when the drive member moves from the neutral portion in the first direction in a state in which the locking lever is arranged at the unlock position, and the drive member is formed to disengage from the double lock lever when the drive member subsequently returns to the predetermined neutral position to allow the double lock lever to move to the second position and disengage the first engagement portion from the locking lever; and
- the drive member is formed to push the double lock lever, which is located at the second position, with the second engagement portion and move the locking lever to the double lock position when the drive member moves again in the first direction from the neutral position.
2. The door lock device according to claim 1, further comprising:
- a base member fixed to the vehicle door; and
- a stopper formed on the base member;
- wherein the drive member is formed to push the locking lever with the first engagement portion and move the locking lever to the lock position at which the double lock lever engages with the stopper while restricting movement of the double lock lever to the second position when the drive member moves from the neutral portion in the first direction in a state in which the locking lever is arranged at the unlock position, and the drive member is formed to be disengaged from the double lock lever when the drive member subsequently returns to the neutral position to allow the double lock lever to move to the second position; and
- the double lock lever is formed to disengage from the stopper when moved to the second position thereby allowing the locking lever to move from the lock position to the double lock position.
3. The door lock device according to claim 2, wherein the base member further includes a guide, and the guide comprises:
- the stopper;
- a first guide portion formed to guide the double lock lever in a state held at the first position when the locking lever moves from the unlock position to the lock position; and
- a second guide portion formed to guide the double lock lever in a state held at the second position when the locking lever moves from the lock position to the double lock position.
4. The door lock device according to claim 2 or 3, wherein the drive member and the locking lever are pivotally supported by the base member so as to be coaxial.
5. The door lock device according to any one of claims 2 to 4, further comprising:
- two hooking projections arranged next to each other on the locking lever; and
- a holding member supported on the base member;
- wherein the holding member is formed to elastically clamp a different number of the hooking projections in correspondence with each of the unlock position, the lock position, and the double lock position of the locking lever.
6. The door lock device according to claim 3, wherein the first guide portion and the second guide portion are arc-shaped.
7. The door lock device according to claim 5, wherein the two hooking projections are integrated with each

other by connecting their adjacent peripheral portions.

8. The door lock device according to any one of claims 1 to 5, further comprising:

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an inside lever linked to the vehicle door and receiving the operation force from the passenger compartment; and

a cancel lever linked to the inside lever and including a third engagement portion engageable with the locking lever;

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wherein the locking lever is pushed by the third engagement portion of the cancel lever to move to the unlock position when the inside lever receives the operation force from the passenger compartment in a state arranged at the lock position; and

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the locking lever is disengaged from the third engagement portion of the cancel lever so that the locking lever does not move when located at the double lock position.

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9. The door lock device according to claim 8, wherein the inside lever is supported by the base member to be pivotal about a rotation axis when arranged at an initial pivot position.

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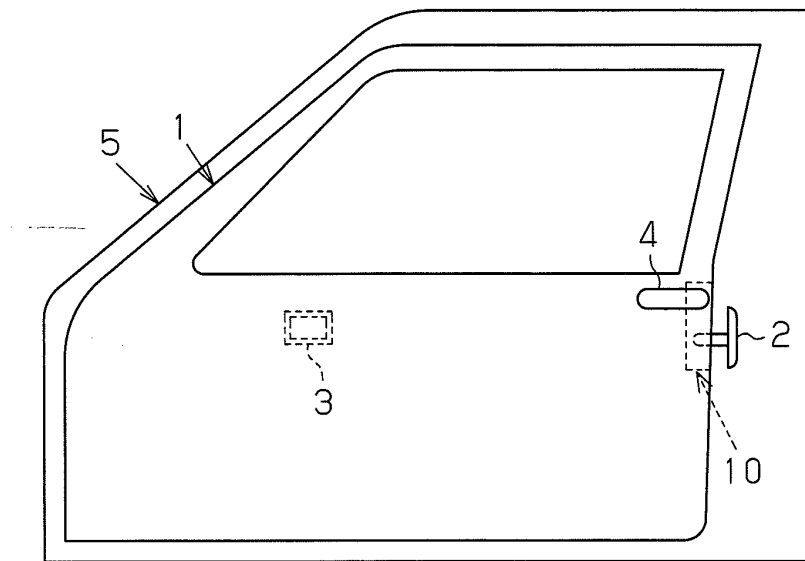
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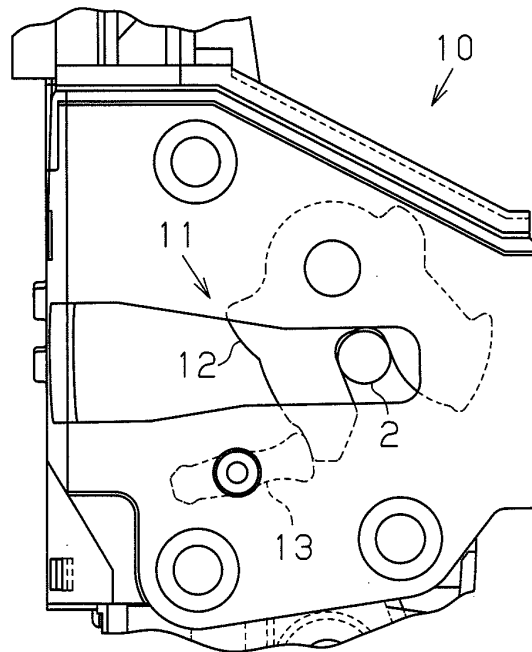
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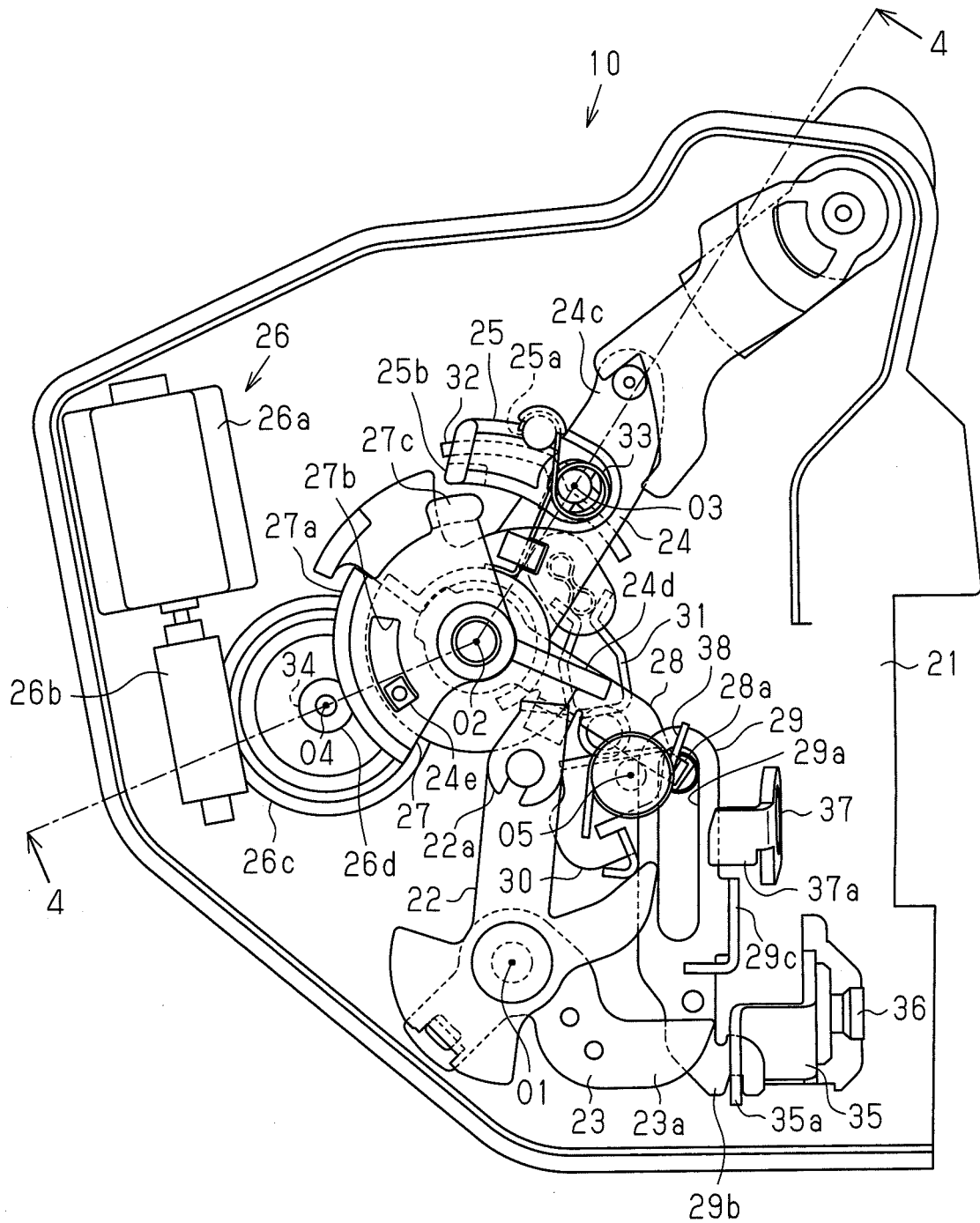
**Fig.1**



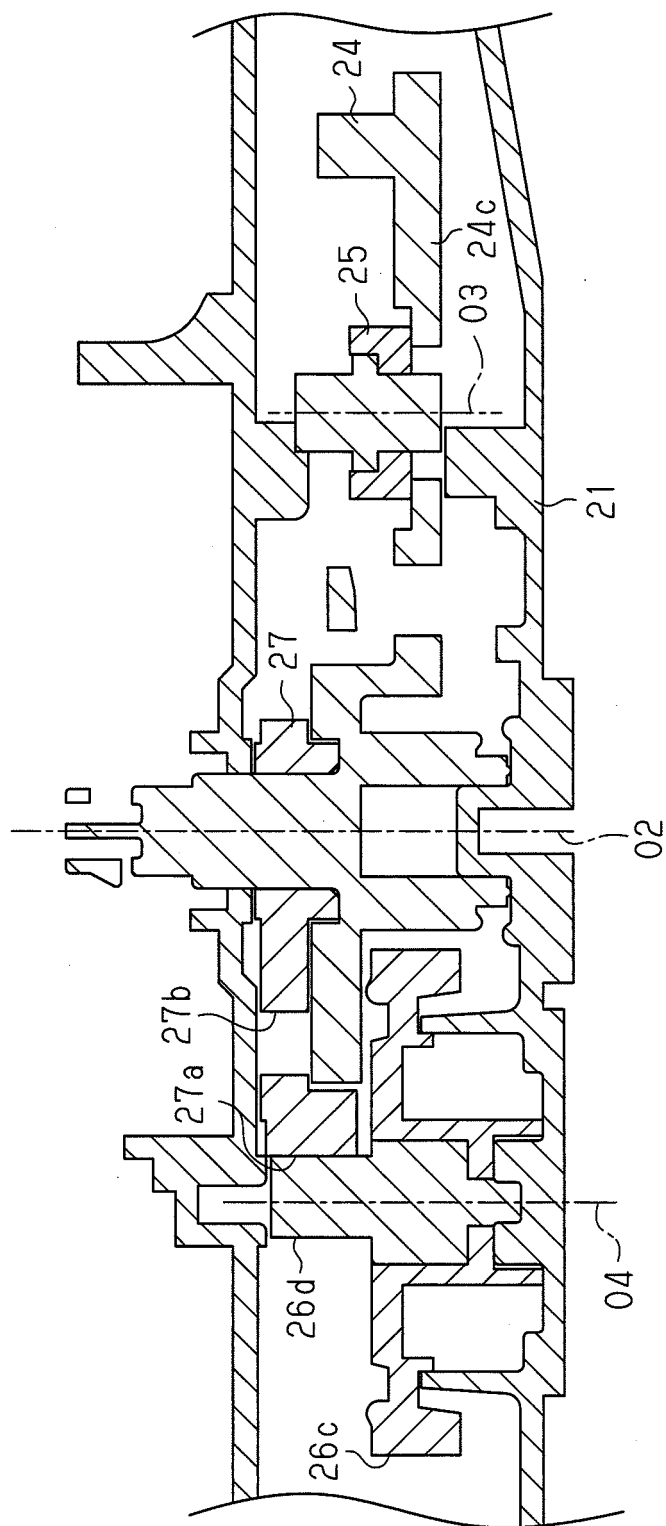
**Fig.2**



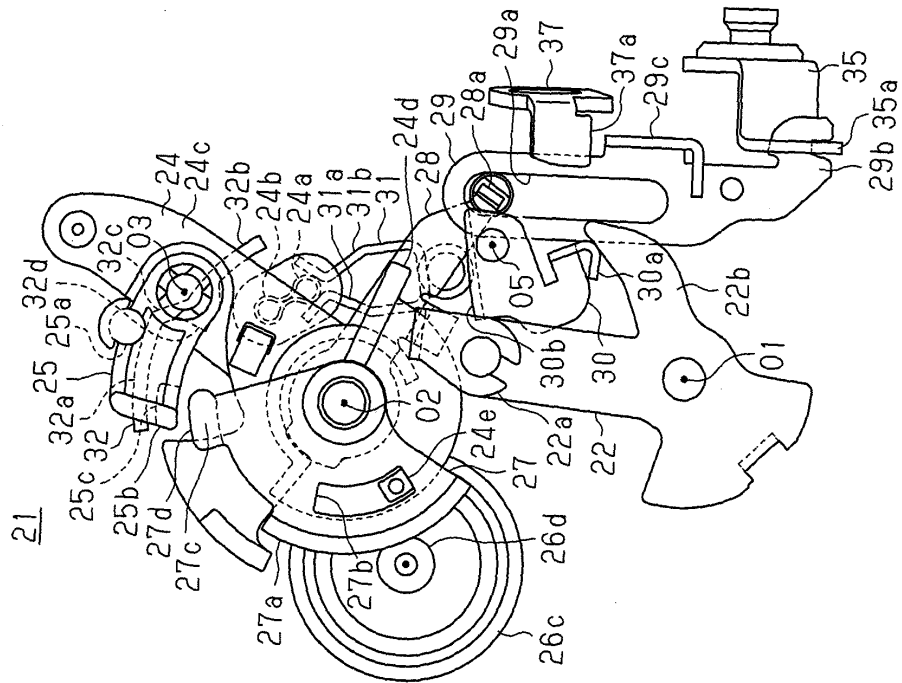
**Fig.3**



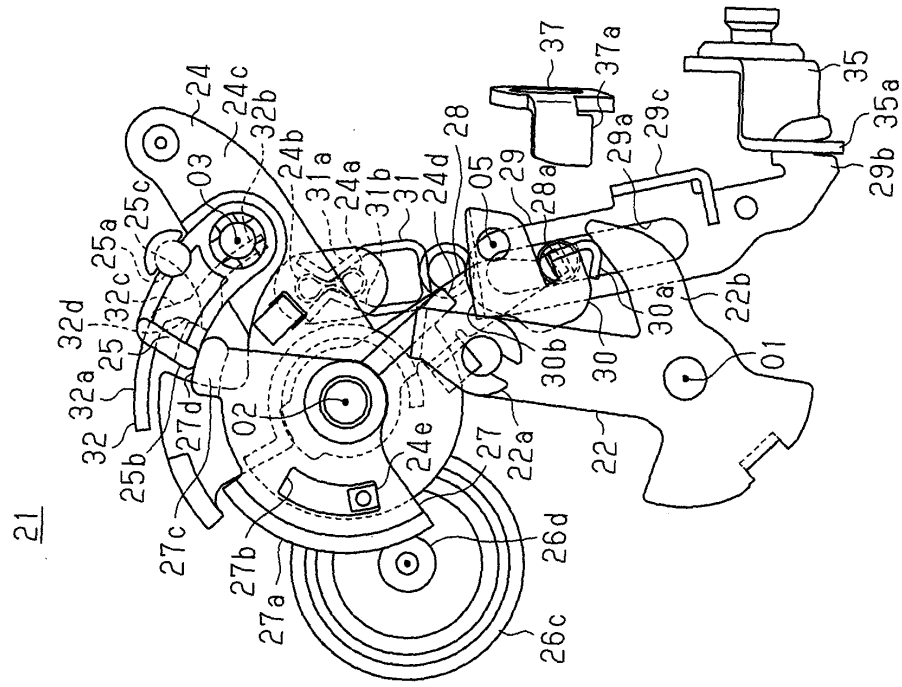
**Fig. 4**



**Fig.5**

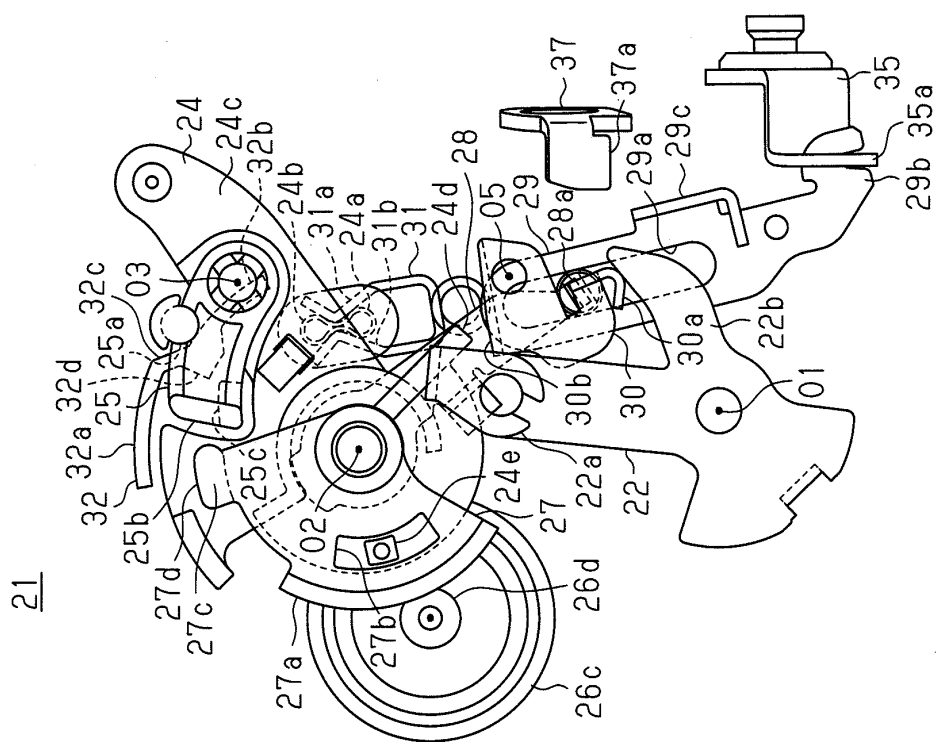


**Fig.6**

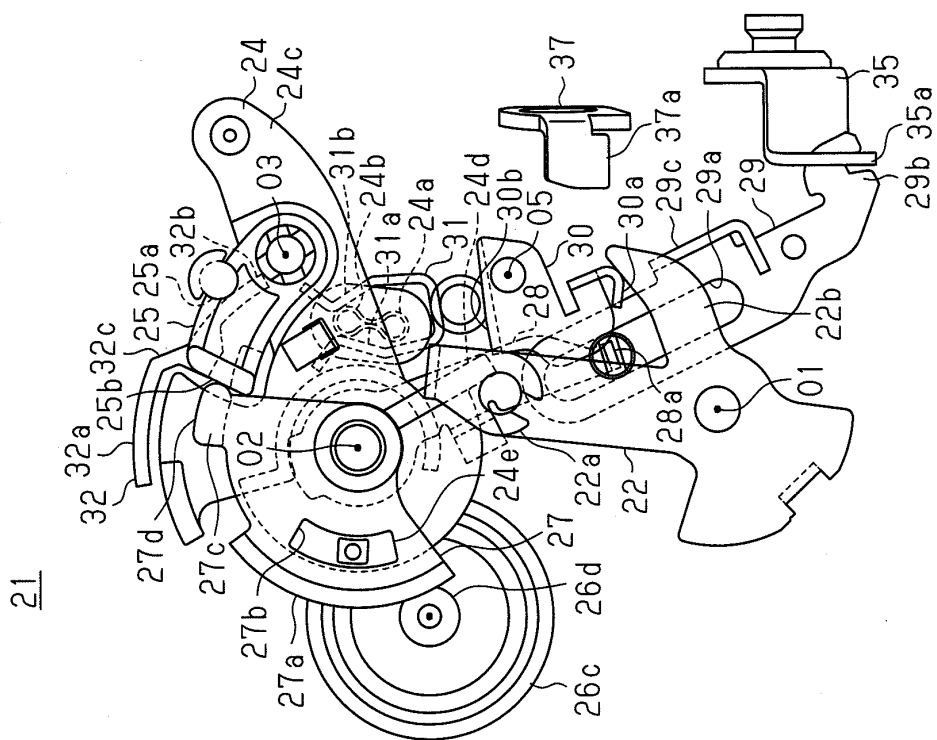




**Fig. 7**

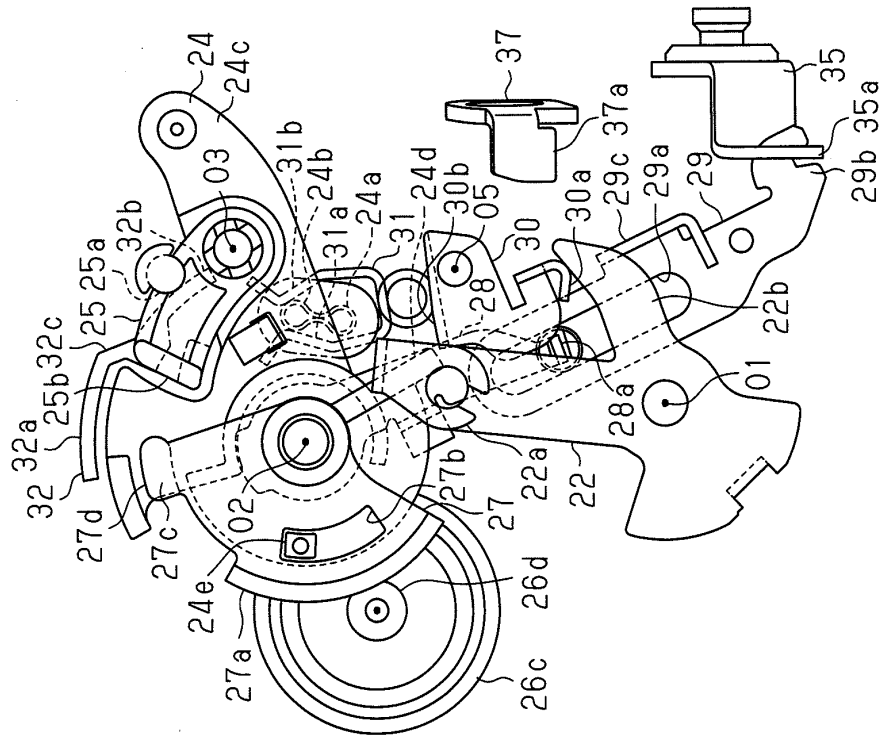


# Fig. 8



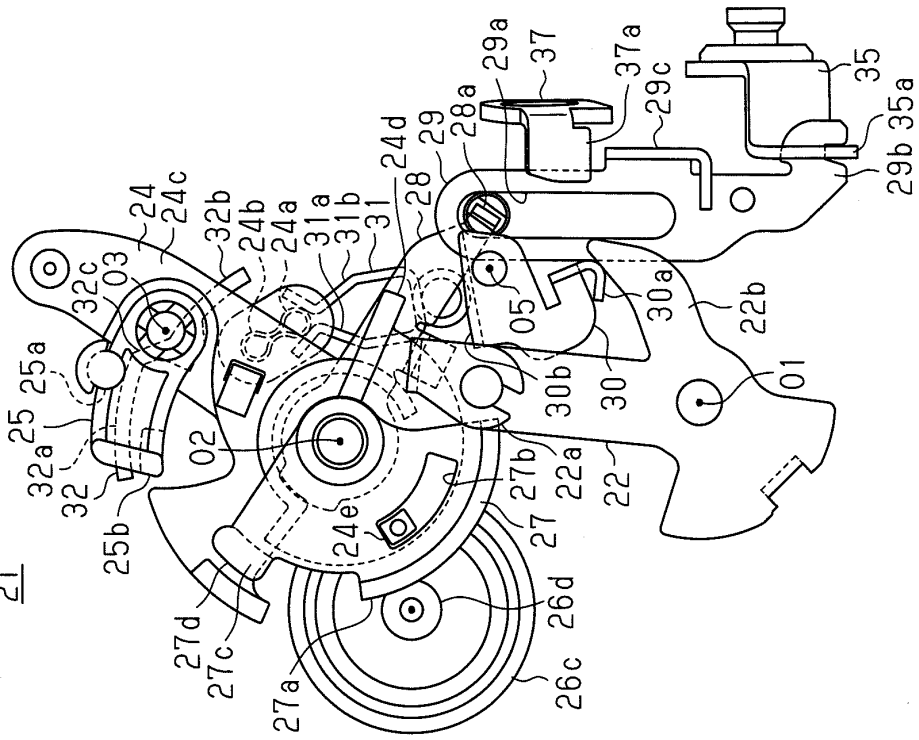
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## Fig. 10

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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2009/065742

A. CLASSIFICATION OF SUBJECT MATTER E05B65/20(2006.01) i, B60J5/00(2006.01) i		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) E05B65/20, B60J5/00		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2009 Kokai Jitsuyo Shinan Koho 1971-2009 Toroku Jitsuyo Shinan Koho 1994-2009		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
E, X	JP 2009-235805 A (Mitsui Mining & Smelting Co., Ltd.), 15 October 2009 (15.10.2009), paragraphs [0069] to [0077] (Family: none)	1, 8, 9
A	JP 4132723 B2 (Ohi Seisakusho Co., Ltd.), 13 August 2008 (13.08.2008), paragraphs [0043] to [0058] & US 6793255 B2 & FR 2824862 A1	1-9
A	JP 2005-126923 A (Aisin Seiki Co., Ltd.), 19 May 2005 (19.05.2005), paragraphs [0062] to [0071] (Family: none)	1-9
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.		
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Date of the actual completion of the international search 07 December, 2009 (07.12.09)		Date of mailing of the international search report 22 December, 2009 (22.12.09)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

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